SPECIFICATION

TITLE OF THE INVENTION

DENTAL BLEACHING AGENT SET AND THE METHOD FOR BLEACHING TEETH

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a teeth-bleaching set and the method for using such a teeth-bleaching set in removing (bleaching), by employing photocatalytic and hydrogen peroxide reactions, coloration and discoloration of teeth resulting from the deposition of pigments on the teeth.

Description of Conventional Art

Generally, whiteness of teeth is an important cosmetic element desired especially by young women and cases of seeking treatments for having whiter teeth increase. A method commonly in use is to use hydrogen peroxide solution.

In other words, in a common teeth-bleaching method, hydrogen peroxide with light or heat is utilized. In this method, a piece of gauze impregnated with hydrogen peroxide solution is

placed on the labial surface of the teeth, and is irradiated, from side to side, with a lamp for about 30 minutes. This requires that the lamp used must be kept as close to the teeth as possible, and the hydrogen peroxide solution must be replenished approximately every five minutes to keep the gauze moist.

There is also a method, in which the irradiation of light from a lamp is replaced by applying a high frequency current for one (1) second with a high frequency electric cautery knife equipped with a spoon-shaped tip, then pausing for eight (8) seconds, and repeating this process for 6 ~ 8 times. In yet another method, in place of a piece of gauze impregnated with hydrogen peroxide solution, a solution (paste) made by mixing a thickener with hydrogen peroxide solution is used as an agent, and is applied directly to the teeth surface.

Besides the above, there are numerous bleaching agents and methods that have been proposed in using combinations of hydrogen peroxide solution, a variety of instruments, and other agents. Among them are: a bleaching method in which a mixture of

hydrochloric acid, hydrogen peroxide solution, and diethylether is used as a bleaching agent; a method in which a paste made from kneading together sodium perborate powder and 30 % by weight of hydrogen peroxide solution is used as a bleaching agent; a bleaching agent in which a mixture of hydrogen peroxide solution with orthophosphoric acid is used and a bleaching method with using it, as seen in Japanese Patent Laid-Open JP-A-08143436; a bleaching agent made by a mixture of anhydrous silicic acid with hydrogen peroxide solution and a method of bleaching a vital teeth by application of said bleaching agent, as seen in Japanese Patent Laid-Open JP-A-05320033; and dental bleaching compositions made from a dental bleaching agent (such as urea hydrogen peroxide, hydrogen carbamide peroxide and carbamide peroxide.) and a matrix material (such as carboxymethylene.), and their respective application methods, as seen in Japanese Patent Laid-Open JP-A-08113520, etc. But these conventional methods that employ hydrogen peroxide have a common shortcoming in that they require a lengthy bleaching time. Also, there is a bleaching

method practiced in the United States in which urea peroxide of about 10 % by weight concentration is used instead of hydrogen peroxide, but due to lengthy time required as in the use of hydrogen peroxide, the results are not satisfactory.

Instead of using hydrogen peroxide solution in bleaching as mentioned above, a dental bleaching method by using a titanium dioxide powder having photocatalytic activities and hydrogen peroxide in low concentration has been proposed, as seen in Japanese Patent Laid-Open JP-A-11092351. However, the conventional bleaching agent employing the titanium dioxide has a poor bleaching efficiency and, in order to meet the satisfactory whitening demanded by patients, a lengthy bleaching time is also needed.

SUMMARY OF THE INVENTION

An objective of the present invention is to provide a dental bleaching agent set and an accompanying dental bleaching method by which the shortcomings associated with the conventional techniques are removed, and thus a higher bleaching efficiency is achieved.

As a result of the earnest investigations made by the present inventors in solving the problems mentioned above, the inventors found that, when the external light activates the conventional bleaching agent that contains approximately 5 % by weight of titanium oxide powder having photocatalytic activities, the light is difficult to reach to the teeth surface where the bleaching action is to take place, due to the sheltering effects of the titanium oxide itself, and hence the bleaching efficiency becomes low. Focusing on this, a new dental bleaching agent set that activates the titanium oxide more efficiently, and the method for applying this bleaching agent is thus completed.

In particular, one aspect of the present invention is a dental bleaching agent set that is characterized by having two components of a first component for previously attaching to a tooth surface comprising an organic solvent containing at least one of a titanium oxide powder, a nitrogen doped titanium oxide powder, and a titanium oxinitride powder having photocatalytic activities and a second component for contacting to the tooth

surface comprising a compound that produces hydrogen peroxide in water, a thickener and a carrier. In the first component, it is preferred to have 0.001 ~ 30 % by weight of at least one of the titanium oxide powder, a nitrogen doped titanium oxide powder, and a titanium oxinitride powder having photocatalytic activities, and it is preferable that the first component also contains at least one of a metal oxide, a metal salt, and a metallic powder in the range of 0.001～10 % by weight. In addition, in some cases, 0.5 ~ 20 % by weight of a thickener and/or water are contained in the first component. It is preferable that the second component has the following composition: a compound that produces hydrogen peroxide in water: 1 ~ 40 % by weight; a thickener: 0.5 ~ 20 % by weight, and a carrier: the balance.

For the titanium oxinitride powder having photocatalytic activities, which is contained in the first component, it is preferred to have a Ti-O-N structure containing nitrogen in its crystalline lattices and exhibit photocatalytic activities in the visible spectral region. It is further preferred

that it carries on its surface, ceramics in an island form, an acicula form, or a mesh form, and also carries a charge separation substance for an increased efficiency.

Also, it is preferred that a pH value is 5.0 ~ 10.0 for the first component and/or the second component, so that the hydrogen peroxide producing compound contained in the second component can be used at a range of high activities.

The other item that is related to the present invention is a dental bleaching method characterized by attaching, on the teeth surface, the first component comprising an organic solvent containing at least one of a titanium oxide powder, a nitrogen doped titanium oxide powder, and a titanium oxinitride powder having photocatalytic activities, followed by an irradiation with light after the second component, containing a compound producing hydrogen peroxide in water, a thickener, and a carrier, is brought to contact to the teeth surface. Specifically, it is preferable that the first component comprising an organic solvent containing 0.001 ~ 30 % by weight of at least one of a titanium

oxide powder, a nitrogen doped titanium oxide powder, and a titanium oxinitride powder having photocatalytic activities, and 0.001 ~ 10 % by weight of one or more of a metal oxide, a metal salt, and a metallic powder, is attached to the teeth surface. It is then irradiated with light after the second component comprising 1 ~ 40 % by weight of a compound that produces hydrogen peroxide in water, 0.5 ~ 20 % by weight of a thickener, and a carrier; is brought to contact on the teeth surface.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Concerning the titanium oxide powder having photocatalytic activities that is used in the dental bleaching agent set and the bleaching method of the present invention, even though any conventionally used titanium oxide powder, be it an antase type, a rutile type or a brookite type, can be used irrespective of its form or characteristics so long as they have photocatalytic activities, but the anatase type titanium oxide powder is preferred. And, the titanium oxinitride powder that has a Ti-O-N structure containing nitrogen in the crystalline lattices of titanium oxide is preferably used. With

regard to the titanium oxinitride powder, it is preferred that it has the same Ti-O-N structure as in the titanium oxide which contains nitrogen in its crystalline lattices, as shown in WO01/10552, and also exhibits photocatalytic activities in the visible spectral region.

The aforementioned titanium oxinitride powder can be made, for example, by heating titanium oxinitride or titanium oxide hydrates under ammonia-containing atmosphere, nitrogen gas-containing atmosphere, or nitrogen and hydrogen gas mixture-containing atmosphere, as is shown in WO01/10552. Further, as is shown in JP-A-2002-154823, the titanium oxinitride powder can also be obtained by heating a mixture of titanium oxide powder and urea; and the titanium oxide powder that does not contain nitrogen on the outer surface can also be used.

Also, for at least one of the titanium oxide powder, the nitrogen doped powder, and the titanium oxinitride powder having photocatalytic activities to be used in the present invention, a powder made in the following methods can also be used as is shown in JP-A-2001-205104. The powder with its

titanium replaced by one or more among vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, ruthenium, rhodium, rhenium, osmium, palladium, platinum, iridium, niobium, molybdenum. And for the nitrogen doped titanium oxide, it is formed by doping one or more of those metals between the crystalline lattices of titanium oxide, or, in the case of a titanium oxide polycrystalline aggregate, doping them at the crystal boundaries.

As for at least one of the titanium oxide, the nitrogen doped titanium powder, and the titanium oxinitride powder for the use in the present invention, the powder may carry ceramics on its surface in an island form, an acicula form, or a mesh form. The ceramics can be chosen, for example, from at least one or more among alumina, silica, zirconia, magnesia, calcia, calcium phosphate, apatite, amorphous titanium oxide, and fluorine resin. These ceramics can easily absorb the deposited pigments on the teeth, and hence enhance the whitening power.

Also, the aforementioned at least one of the titanium oxide powder, the nitrogen doped titanium

oxide powder, and the titanium oxinitride powder having photocatalytic activities may carry charge separation materials. The charge separation materials can be selected, for example, from one or more among Pt, Pd, Ni, RuO_x, NiO_x, SnO_x, Al_xO_y, and ZnO_x. These charge separation materials can effectively prevent the recombination of electrons and positive holes by capturing electrons or positive holes, and therefore, allow the photocatalytic reaction to proceed more effectively, thereby improving the whitening efficiency.

As to the particle diameter of at least one of the titanium oxide powder, nitrogen doped titanium oxide powder, and the titanium oxinitride powder having the photocatalytic activities, although a suitable diameter range is 1 ~ 500 nm, the range of 5 ~ 200 nm is preferred. As to the proper amount of the powder having the photocatalytic activities in the first component, even though a small amount will be quite effective, yet a insufficient amount will sometime require, depending on the degree of discoloration of the teeth, a lengthy time in obtaining the desired results. On the other hand, an

excessive quantity of the powder will, due to its own property of sheltering from light, possibly lower the whitening effectiveness. Therefore, the quantity of the powder in the first component is preferred to be 0.001 ~ 30 % by weight, or better at 0.001 ~ 10 % by weight, or even better at 0.01 ~ 2 % by weight.

In the dental bleaching agent set and dental bleaching method of the present invention, it is necessary to use an organic solvent to enhance the attachment, to the teeth surface, of the first component that contains at least one of the titanium oxide powder, the nitrogen doped titanium oxide powder, the titanium oxinitride powder having photocatalytic activities. From the operational perspective of attachment to the teeth surface, the preferred solvents are, for example, alcohols such as ethanol, glycerin, ethylene glycol, diethylene glycol, and propylene glycol, or polyhydric alcohols. Among the polyhydric alcohols, for example, polyethylene glycol, polypropylene glycol, sorbitol, mannitol by themselves or their mixtures are

preferred for their superior safety and excellent affinity to the teeth.

Concerning the first and the second components of the present invention of the dental bleaching agent set and dental bleaching method, it is preferred that the pH value is adjusted to a range of 5.0 ~ 10.0. This is to improve the activity level of the compound that produces hydrogen peroxide in water, present in the second component applied to teeth after the first component. If the pH value is less than 5.0, the dentin is liable to be decalcified, and if higher than 10.0, the proteins in the dentin are liable to be denatured.

According to the present invention of the dental bleaching agent set and the dental bleaching method, it is preferable to incorporate one and more of a metal oxide, a metal salt, and a metal powder in the first component, in order to improve the activities of the compound that produces hydrogen peroxide in water and is contained in the second component subsequently applied. The incorporation of one or more of the metal oxide, a metal salt, and a metal powder must be in the first component instead of the

second component, in order to avoid a vigorous reaction that will occur between these and the compound producing hydrogen peroxide in water that is contained in the second component. As to the metal oxide, the metal salt, and the metal powder, there is no special limitation so long as they react with the compound that produces hydrogen peroxide in water. However, the preferred metal oxide are manganese oxide, platinum oxide, ruthenium oxide, titanium oxide, and iron oxides. Among the preferred metal salts that can be cited are aluminum chloride, aluminum acetate, aluminum salicylate, aluminum acrylate, aluminum hydroxide, aluminum nitrate, aluminum carbonate, aluminum lactate, aluminum sulfate, itaconic acid aluminum, aluminum phosphate, aluminum polychloride, aluminum iodide, iron chloride, iron sulfate, iron nitrate, iron hydroxide, iron ammonium sulfate, iron citrate, iron succinate, iron bromide, iron phosphate, iron dichloride, iron ethylene diamine, iron oxalate, tin chloride, tin acetate, tin phosphate, tin diphosphate. Under a certain circumstance, two or more of the above compounds may be used. As to the metal powder, the

powders of platinum, gold, ruthenium, various stainless steel, and titanium are preferred. A suitable average diameter of these powder particles is 1 ~ 500 nm, and a range of 5 ~ 200 nm is preferred. As to the proper quantity of these powder particles in the first component, 0.001 ~ 10 % by weight is suitable, and 0.001 ~ 5 % by weight is preferred, and 0.01 ~ 1 % by weight is even more preferable. Even the presence of a small quantity of these powder particles will show its effectiveness, but with an insufficient quantity, it is liable not to improve the bleaching effects. On the other hand, when an excessive quantity of these powder particles is used, it is liable not to achieve effective whitening of the teeth due to the excessive thickness of film that is formed on the teeth surface.

In the first component of the dental bleaching agent set and the method of the dental bleaching of the present invention, in order to make the powder having photocatalytic activities stay on the teeth surface effectively, and to improve the ease in applying it to teeth, it is preferable to further

contain 0.5 ~ 20 % by weight of a thickener. When the quantity of the thickener is below 0.5 % by weight, it is difficult to realize the effect of a thickener, and when it exceeds 20 % by weight, it is liable to cause difficulties in application due to solution's excessively high viscosity. As to the thickener, there is no especial limitation on those that are used in traditional dentistry, and a wide variety of synthetic, natural and inorganic thickeners can be used. Among synthetic thickeners that can be used are cellulose sodium glucolate, sodium alginate, alginic acid propylene glycol ester, carboxy polymethylene, sodium carboxymethyl cellulose, calcium carboxymethyl cellulose, methyl vinylether/anhydrous maleic acid, starch sodium glycolate, starch sodium phosphate ester, sodium polyacrylate, methyl cellulose, hydroxy propylcellulose, and polyvinyl pyrrolidone. Among natural thickeners that can be used are guar gum, bean gum, tara gum, tamarind seed gum, gum arabic, tragant gum, karaya gum, alginic acid, carageenan, xanthan gum, gellan gum, curdlan, chitin, chitosan, and chitosamine. Among inorganic thickener that can

be used are calcium carbonate, calcium silicate, magnesium silicate, sodium magnesium silicate, silica powder, amorphous hydrous silicic acid, and fumed silica. It has been confirmed from experiments that a suitable viscosity range obtained with the thickener is 0.2 ~ 30 Pa·s (25 °C). The quantity of the thickener needed to reach this viscosity range is depending on the thickener used, and, therefore, the suitable quantity is determined on an individual basis.

According to the present invention of the dental bleaching agent set and the dental bleaching method, water is sometime added to the first component based on the consideration of the reactivity of the powder having the photocatalytic activities. The quantity of water that is mixed into the first component is preferably 1 ~ 30 % by weight. If it is less than 1 % by weight, at least one of the titanium oxide powder, the nitrogen doped titanium powder, and titanium oxinitride powder will not react sufficiently, and for over 30 % by weight, the first component tends to hardly dry on the teeth surface.

According to the present invention of the dental bleaching agent set and the dental bleaching method, there is no special limitation for a compound producing hydrogen peroxide in water, that is contained in the second component, so long as it can produce hydrogen peroxide in an aqueous solution. For example, hydrogen peroxide, perborate, percarbonate, perphosphate, persulfates, calcium peroxide, magnesium peroxide, and urea peroxide can be cited, but hydrogen peroxide and urea peroxide are preferred. It is preferable for the second component to contain 1 ~ 40 % by weight of these compounds that produce hydrogen peroxide in water, and it is even more preferable to contain 1 ~ 15 % by weight. If the second component contains the compound producing hydrogen peroxide in water less than 1 % by weight, it is difficult to achieve whitening effects, and for more than 40 % by weight, the improvement in whitening effects is hardly noticeable while compromising the safety.

According to the present invention of the dental bleaching agent set and the dental bleaching method, it is necessary to add a thickener to the second

component containing a compound that produces hydrogen peroxide in water, in order to make the compound stay effectively on the teeth surface and for the ease in application, and the quantity of the thickener therein is preferred to be 0.5 ~ 20 % by weight. If it is less than 0.5 %, the effect of adding a thickener is hard to be achieved, and for more than 20 % by weight, the viscosity is too high for an easy application onto the teeth surface. As to the thickeners, those aforementioned thickeners that can be mixed in the first component can also be used. According to the experiments, the viscosity with the addition of the thickener is preferred to be 0.2 ~ 30 Pa·s (25 °C), the same as the first component with a suitable thickener added.

According to the present invention of the dental bleaching agent set and the dental leaching method, it is necessary to incorporate, in the second component, a carrier as a basic ingredient for stabilizing and dispersing the compound that produces hydrogen peroxide in water. By incorporating a carrier, or a combination of carriers thereof, in accordance with the thickeners

described above, it is possible to adjust the concentration of the chosen compound that produces hydrogen peroxide in water, and the viscosity of the second component. As to the carrier, water, sorbitol, glycerol, stearyl alcohol, glycerin, ethylene glycol, diethylene glycol, polyethylene glycol, propylene glycol, polypropylene glycol, mannitol, and other polyols can be used.

It is of course possible to contain, to the extent not to lower the effectiveness of the first and the second components according to the present invention of the dental bleaching agent set and the dental bleaching method, ordinary additives such as sweetners, fragrances, preservatives and stabilizers.

In performing the dental bleaching method in accordance with the present invention, the first component, consisting of an organic solvent and at least one of the titanium oxide powder, the nitrogen doped titanium oxide powder, and the titanium oxinitride powder having photocatalytic activities, is attached to the teeth surface first. The easiest way of attaching a layer of the first component to

the teeth surface is by applying it directly on the teeth surface with a brush or the like.

It is then followed by bringing the second component, containing a thickener, a carrier, and a compound that produces hydrogen peroxide in water, to contact to the teeth surface. The easiest method of contacting this second component to the teeth surface is by directly applying it on the teeth surface with a brush or the like as done for the first component. Other methods include impregnating the second component in a sufficiently translucent material, such as cloths, papers, glass cloths, ceramic papers, organic gels, inorganic gels, and bring it to a contact at the teeth surface. Another method is by keeping the second component in a suitable and sufficiently translucent resin retainer in the shape of a mouth guard, then followed by a proper and suitable method in bring the second component to contact to the teeth or teeth raw surface where the first component was already attached. And subsequently, irradiation of light is performed.

For the light source (irradiation equipment) to be used in performing the dental bleaching method of the present invention, in general, the use of incandescent lights, fluorescent lights, halogen lamps, xenon lamps, mercury lamps, and UV lamps can be cited. But from the viewpoint of safety, convenience, and the whitening effects, LED (light emitting diode) and semiconductor lasers are especially preferred. As to the irradiating light, it is desirable, from the viewpoint of production of the active oxygen, via photocatalytic reaction arising from the photocatlytic activities of the powder, and its subsequent oxidation reaction, a light that is abundant in energetic short wave such as the ultraviolet light is preferred. But the ultraviolet light is harmful in causing inflammation and cancers in human body, and, therefore, from the viewpoint of safety, the use of a visible light, especially with energetic violet and/or blue lights, is preferable.

The dental bleaching method of the present invention is performed by a sequential steps of attaching the first component to the teeth surface,

followed by contacting the second component on the first component, and then irradiating light. These sequential steps of treatment can be repeated several times. As to the number of applications required of these sequential steps of attachment, contacting, and irradiation by light, it is adjusted according to the degree of discoloration of the teeth. In practice, generally the dental bleaching set applied on teeth surface is replaced by a new one in about 5 ~ 20 minutes, and such interval and frequency are determined according to the condition of the teeth, the type and the concentration of the compound used in generating oxygen in water. The dental bleaching agent set and dental bleaching method of the present invention is effective in whitening both demyelinated and myelinated teeth, safely and conveniently, and, above all, with remarkable results.

EXAMPLES

The present invention will be explained next with the following examples, but it is not to be construed as the limitation of the present invention.

<Production of the first component>

As shown in Tables 1 ~ 2, added, while stirring, into one or more of organic solvents such as ethanol, glycerin, polyethylene glycol (average molecular weight 200), were the titanium oxide powder or the titanium oxinitride powder having the photocatalytic activities, and, as needed, a metal powder such as platinum powder or iron chloride. After their dispersal, thickeners, such as sodium magnesium silicate or silica fine powder (trade name: Aerosil R972, manufactured by Nippon Aerosil Co., Ltd.) was added little by little, as needed, to produce the first component of the dental bleaching agent set. The product was then sealed in a light shading container.

For the titanium oxide powder or titanium oxinitride powder, the following were used.

<Powder A>

A commercially available titanium dioxide powder (Trade name: ST-01, manufactured by Ishihara Sangyo Kaisha, Ltd) is used.

<Powder B>

For the titanium oxinitride powder having a Ti-O-N structure, the following were used. Produced by

heating, at 450 °C for 30 minutes, a mixture of urea and a commercially available titanium dioxide powder (Trade name: ST-01, manufactured by Ishihara Sangyo Kaisha, Ltd), as shown in JP-A-2002-154823.

<Powder C>

For the titanium oxinitride powder having a Ti-O-N structure, the following were used. Produced by heating, at 600 °C for 3 hours and under the atmosphere of argon and ammonia gas mixture, a commercially available titanium dioxide powder (Trade name: ST-01, manufactured by Ishihara Sangyo Kaisha, Ltd), as shown in WO01/10552.

<Powder B-Ap>

Produced by supporting apatite on the surface of the aforementioned powder B by the method shown in WO01/10552.

<Powder C-Pt>

Produced by supporting platinum on the surface of the aforementioned powder C by the method shown in JP-A-2001-205103.

<Production of the second component>

As shown in Table 3, a carrier was made from one or more of polypropylene glycol, polyethylene glycol,

and glycerin, and water. Then the following were added to the carrier to produce the second component of the dental bleaching agent set: hydrogen peroxide and/or urea peroxide as the compound for producing hydrogen peroxide in water; and one or both of sodium magnesium silicate and silica fine powder (trade name: Aerosil R972, manufactured by Nippon Aerosil Co., Ltd.) and carboxy polymethylene (trade name: Carbopol 940, manufactured by BF Goodrich, Co.) as a thickener.

In the following Examples, the combinations among a variety of aforementioned first component, labeled from 1 ~ 10, and that of the second component, labeled from 1 ~ 4, are shown.

In particular, the combinations between the second component 1 and each of the first component 1 ~ 5 are shown in the Examples 1 ~ 5. The combinations between the second component 2 and each of the first component 6 ~ 10 are shown in the Examples 6 ~ 10. The combinations between second component 3 and each of the first component 1 ~ 10 are shown in Examples 11 ~ 20. The combinations between the second component 4 and each of the first

component 1 ~ 10 are shown in the Examples 21 ~ 30. For the second component 4, two solutions with a volume ratio of 1:1 were mixed immediately before use. The Comparative Example 1 which serves as the composition representing the conventional dental bleaching agent is a mixture of 3 % by weight of titanium dioxide powder (Trade name: ST-01, manufactured by Ishihara Sangyo Kaisha, Ltd.) and 10 % by weight of hydrogen peroxide in water; while the Comparative Example 2 is prepared by adding enough water to 9.94 g of hydrogen peroxide, 0.60 g of phosphoric acid, and 2.00 g of sodium pyrophosphate ten hydrates to make a total weight of 60 g.

TABLE 1 (% by weight)

	first component 1	first component 2	first component 3	first component 4	first component 5
powder A	5			7	
powder B		2			1
powder C			2.5		
water	30	25	25		25
ethanol	61	10			
glycerin		59.95	69.5	38	
polyethylene glycol				53	71.95
platinum powder		0.05			0.05
iron chloride	1		1		
sodium magnesium silicate	3	3			
silica fine powder			2	2	3
total	100	100	100	100	100

TABLE 2 (% by weight)

	first component 6	first component 7	first component 8	first component 9	first component 10
powder B-Ap	1.5	2	4		
powder C-Pt		3		5	5
water				10	5
ethanol	95	85	83.5	70	80
glycerin		8			
polyethylene glycol			10	14	
platinum powder	0.5		0.5		
iron chloride					2
sodium magnesium silicate	3	2	2	1	4
silica fine powder					4
total	100	100	100	100	100

TABLE 3 (% by weight)

	second component 1	second component 2	second component 3	second component 4	
polypropylene glycol		40			
polyethylene glycol			10		
glycerin	16.5	14	20	76.5	
water	60	10	31.5		61.5
hydrogen peroxide	20	10			35
urea peroxide		20	30	20	
sodium magnesium silicate			3		
silica fine powder		2.5	2		
carboxy polymethylene	3	3	3	3	3
sodium hydroxide (pH adjusted)	0.5	0.5	0.5	0.5	0.5
total	100	100	100	100	100

<Method of Using>

The following procedures were followed for the application of the aforementioned Examples and Comparative Examples.

(1) A pretreatment is applied to the object teeth in removing dental plaques, dental calculi, and tars on the teeth surface with a supersonic scaler.

(2) The teeth surface was cleaned with a rubber cup or the like by a usual method and dried.

(3) Kept dry by using a rubber dam.

(4) For each of the Examples, the first component was applied on the teeth surface with a brush, let stand for 20 seconds, and then dried with air.

(5) The second component was applied on the teeth surface for each of the Examples shown, while for the Comparative Examples, a dental bleaching agent was applied, or for the viscous ones, attached on the teeth surface. It was then followed by irradiation with a dental visible light irradiator (trade name: Labolight LVII, manufactured by GC Corporation.) for five minutes per irradiation. The

distance between the irradiator and the teeth surface was about 1 cm.

(6) At an interval of 10 ~ 30 minutes, a fresh dental bleaching agent was applied on and the irradiation was repeated.

(7) For evaluating the effectiveness of the bleaching visually, the dental shade guide (trade name: Lumin-vacuum, manufactured by Bita Co.) was used as the reference for judging the teeth color, before and after the bleaching, and the color were recorded by a video camera. Thereafter, evaluations by the patients were conducted by viewing the images recorded before and after the bleaching. Table 4 summarized patients' judgments according to the following categories:

+++: the patient was greatly satisfied

++: the patient felt somewhat satisfactory about the results of bleaching

+: the patient noticed some effects of bleaching but not satisfied with some remaining discoloration

TABLE 4

	site	accumulated irradiation time (minutes)	color shade of teeth		effects
			before treatment	after treatment	
Example 1	maxilla left 1	90	B4	B2	+++
Example 2	maxilla left 2	100	A4	A2	+++
Example 3	maxilla right 1	80	A3.5	A2	+++
Example 4	maxilla left 3	90	A3.5	A2	+++
Example 5	maxilla right 2	100	D4	D2	++
Example 6	mandible left 1	70	B3	B1	+++
Example 7	mandible left 2	65	B3	B1	+++
Example 8	maxilla right 3	80	A4	A2	+++
Example 9	maxilla right 3	90	B4	B2	+++
Example 10	maxilla left 2	80	C4	C2	+++
Example 11	maxilla right 2	120	A3.5	A2	+++
Example 12	mandible left 3	100	B4	B2	+++
Example 13	mandible left 2	90	C4	C2	+++
Example 14	mandible right 1	90	C4	C2	+++
Example 15	mandible right 2	80	A3.5	A2	+++
Example 16	mandible left 2	100	A4	A3	+++
Example 17	mandible left 1	90	A3.5	A2	+++
Example 18	maxilla left 1	120	A3.5	A2	+++
Example 19	maxilla right 2	100	C4	C2	+++

Example 20	mandible left 1	90	B4	B2	++
Example 21	mandible left 2	60	B3	B1	++
Example 22	maxilla right 3	60	A3.5	A2	+++
Example 23	maxilla right 3	50	A3.5	A2	+++
Example 24	maxilla left 2	30	D4	D2	+++
Example 25	maxilla left 2	55	A4	A2	+++
Example 26	mandible right 2	65	B3	B1	+++
Example 27	mandible left 2	70	B4	B2	+++
Example 28	mandible left 1	60	C4	C2	+++
Example 29	maxilla left 1	50	A3.5	A2	+++
Example 30	mandible left 3	85	B3	B1	+++
Comparative Example 1	maxilla right 3	100	A3.5	A3	+
Comparative Example 2	mandible right 2	65	B3	B2	+

From the foregoing results, it was confirmed that highly whitening results were achieved by using the dental bleaching agent set of the present invention and following the dental bleaching methods of the present invention.

As has been described in detail, the present invention of dental bleaching agent set and the dental bleaching method remove the shortcomings of the conventional bleaching agent that the light is

difficult to reach to the powder on the teeth surface where the bleaching action is to take place due to its own sheltering effects of titanium oxide powder, when the external light is to activate the photocatalytic activities of the titanium oxide having photocatalytic activities contained by about 5 % therein. The present invention effectively activates the powder having photocatalytic activities for bleaching and thus contributes greatly to the field of whitening teeth.